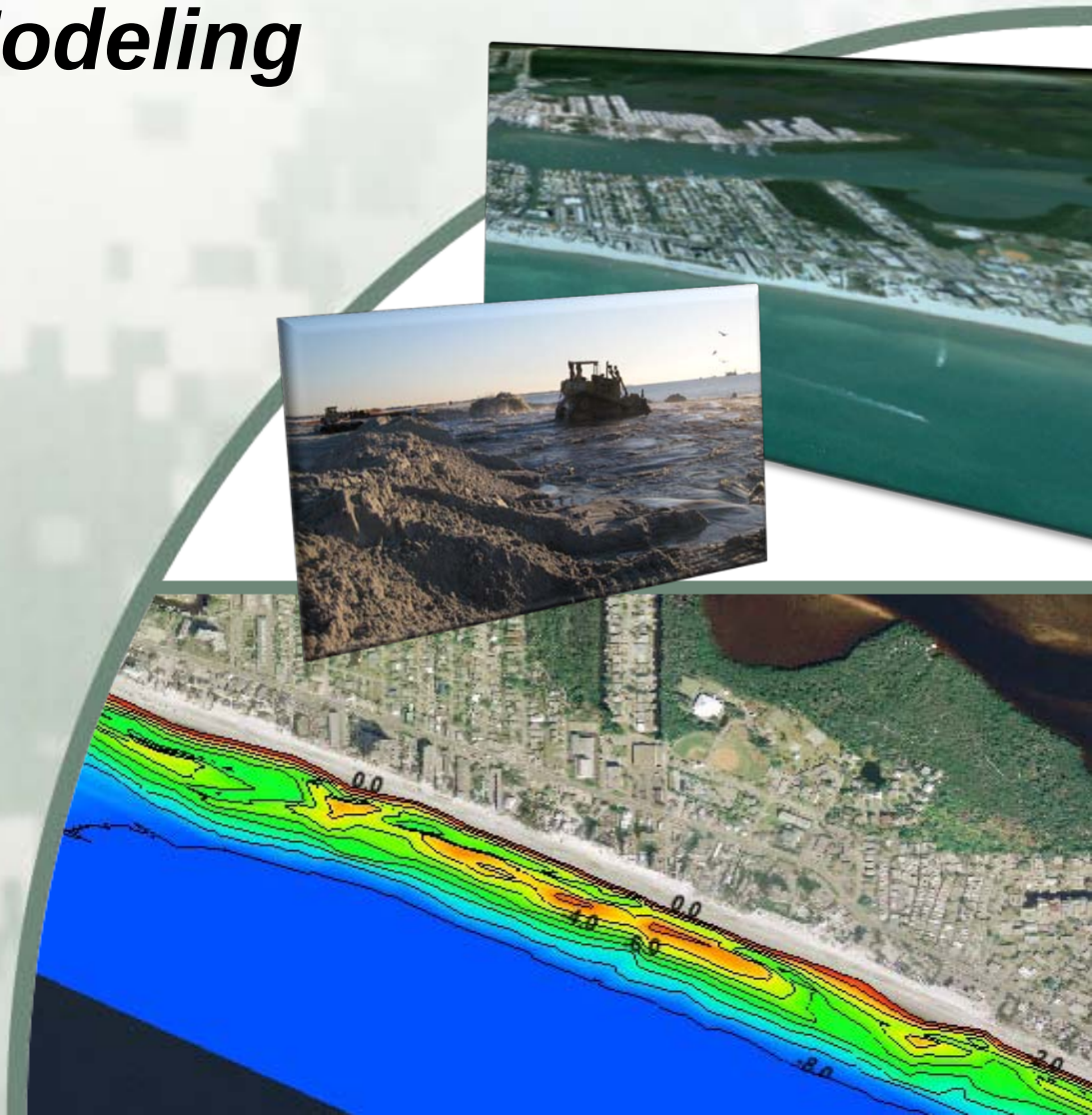
Nearshore Berm Sediment Transport & Migration: *Measurements & Modeling*



Nearshore Berm Workshop
13 February 2013

US Army Corps of Engineers®

Report Documentation Page

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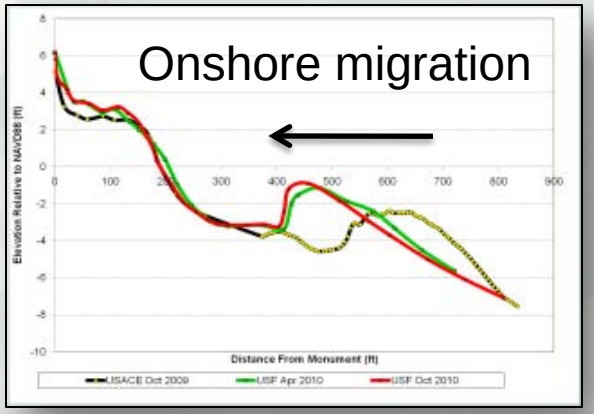
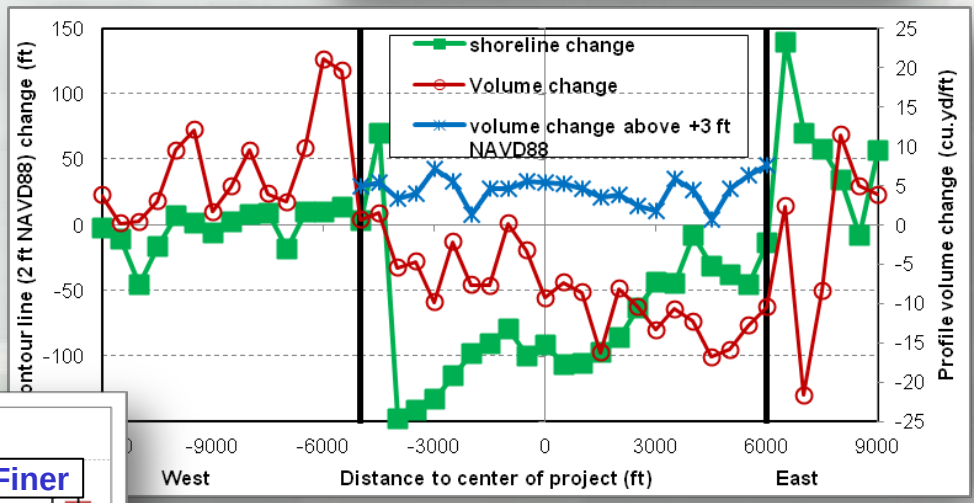
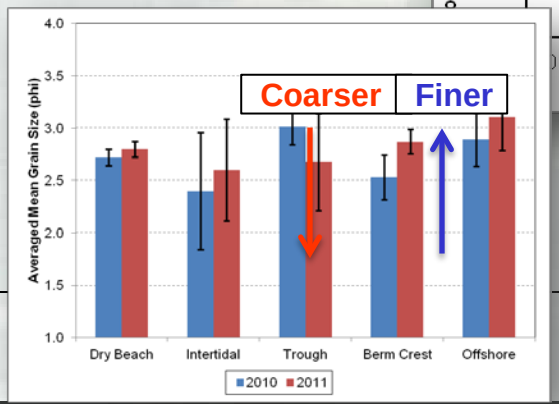
Definitions

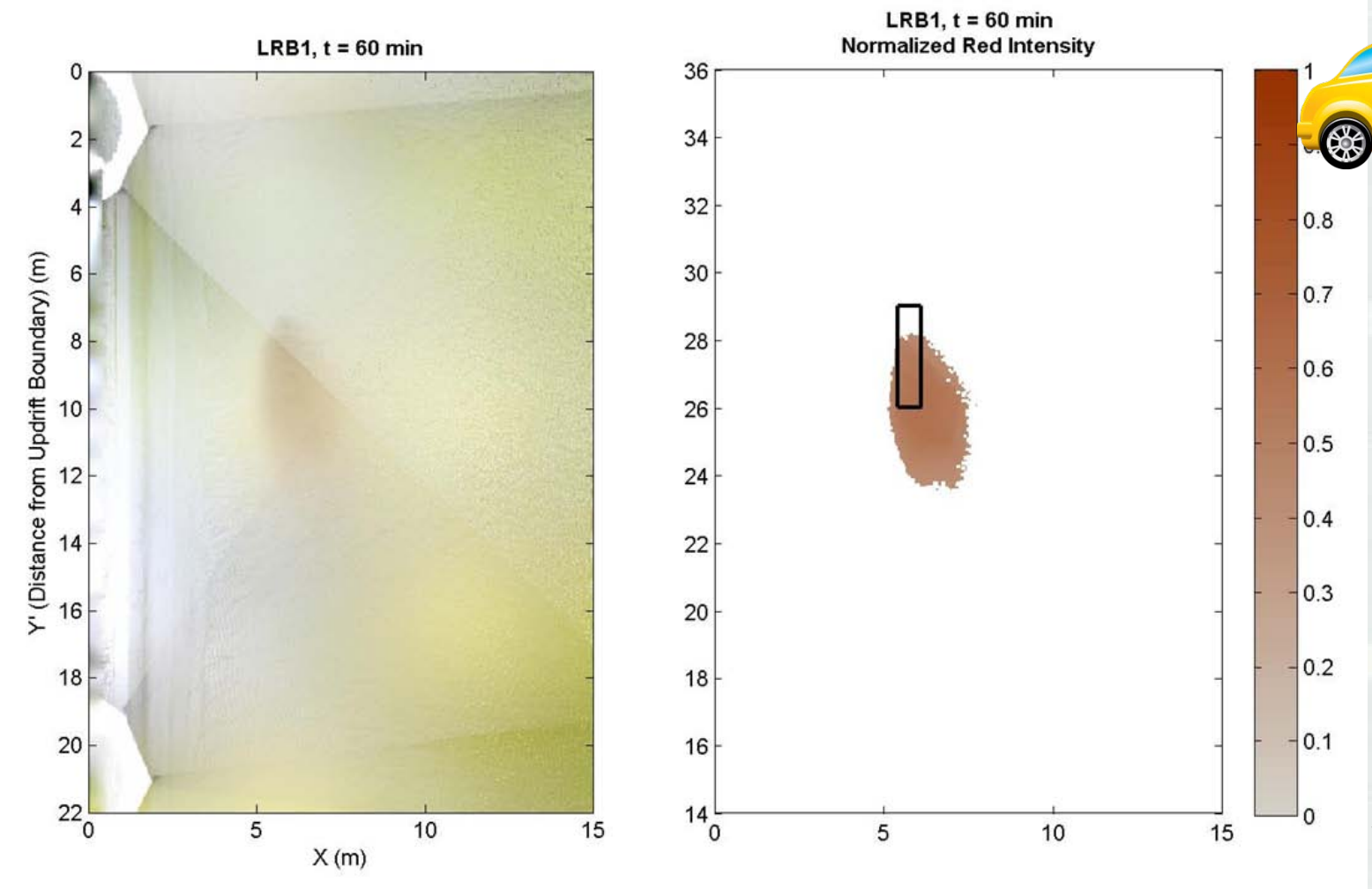
- **Cross-shore Transport Vs. Alongshore Transport**
  - **Where is the beach accreting?**
    - **Adjacent beach or region of nourishment**
  - **How much is it accreting by?**
    - **Shoreline change or profile volume**
  - **What is the long-term fate of the material?**







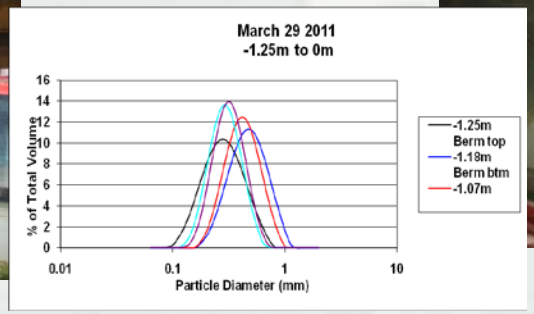
Large-scale Sediment Transport Facility

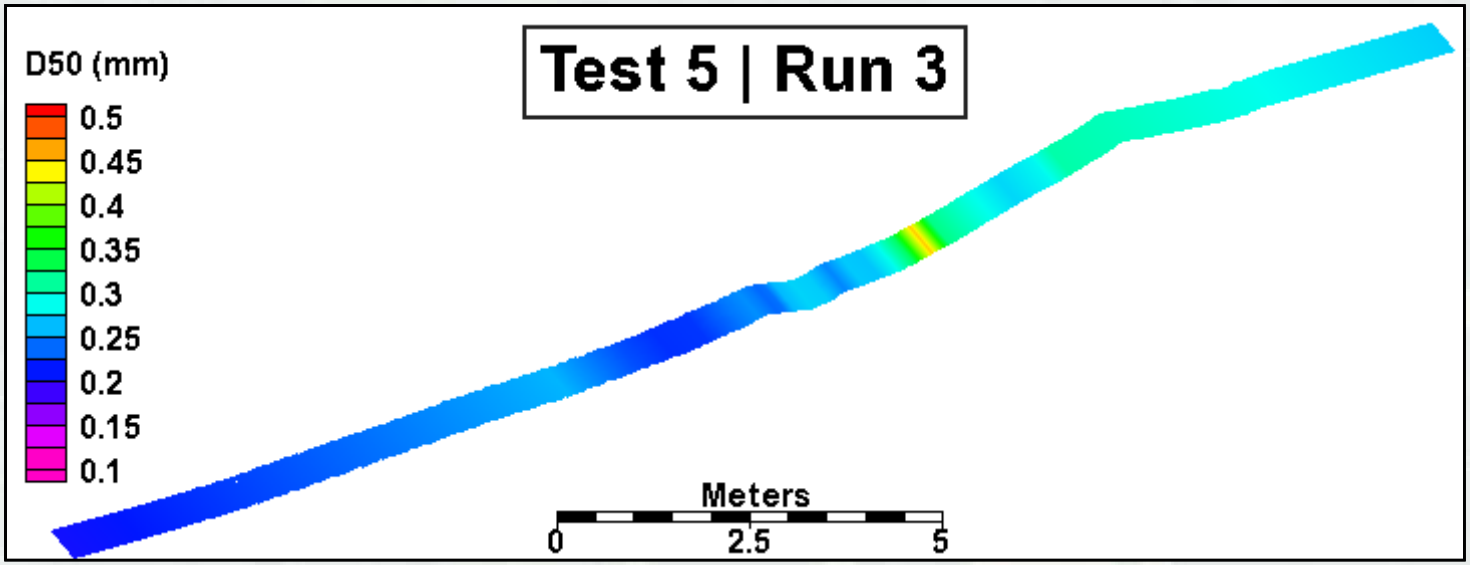


Dr. Ernest Smith, CHL (Funded by LRB)

- **Alongshore Processes: Longshore current-driven advection**
- Cross-shore Processes: Wave-driven diffusion across the surf zone

3-ft Wave Flume: Cross-shore Sediment Transport

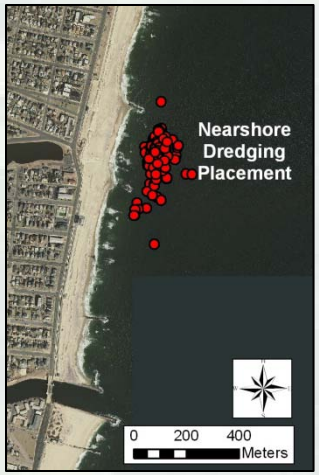




Tanya Beck, CHL (Funded by CHL-IRIP)

- Alongshore Processes: Longshore current-driven advection
- **Cross-shore Processes: Wave-driven diffusion across the surf zone**

The Variation of Placement Types



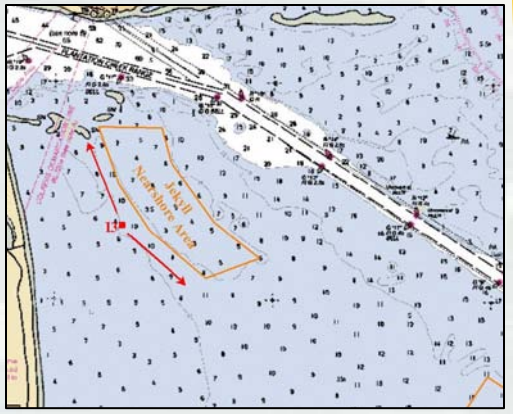
Shark River Inlet (NAN)

Small Dispersive Placements

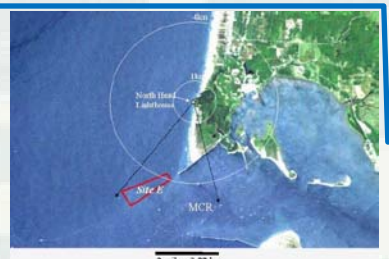
Assateague Island, MD (NAB)

Perdido Key (SAM)

Large, Designed Migrational Placements



Brunswick (SAS; DOER)



Benson Beach Beneficial Use Placement; North and South Jetty Placements at MCR (NWP)

Research Supported Monitoring Projects in Collaboration with SAJ & SAM

Perdido Key Swash Zone Berm (Jan 2012)

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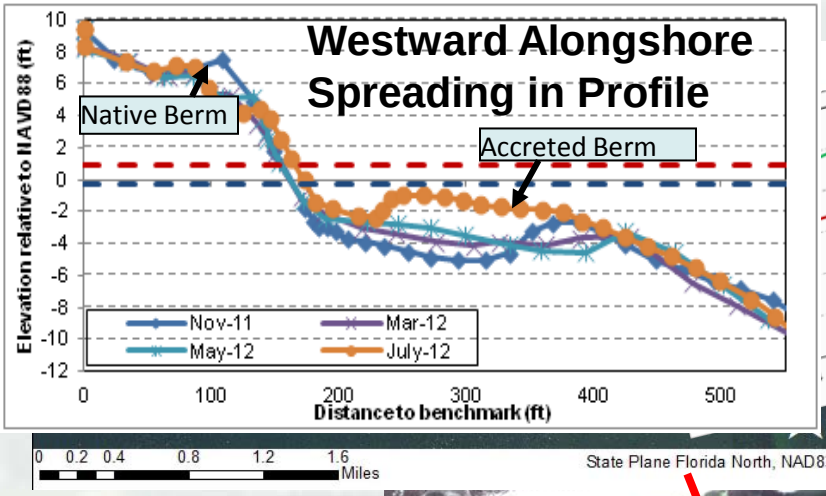

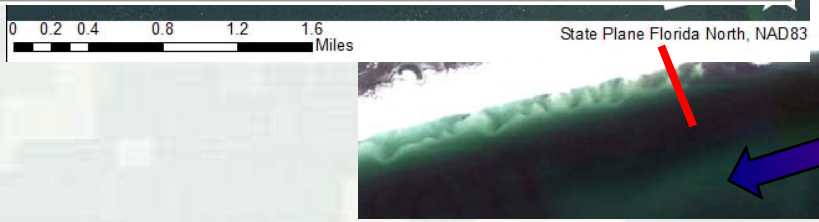

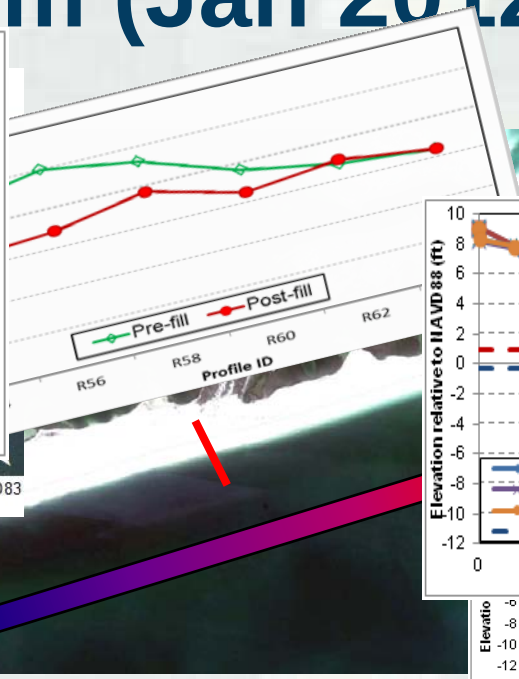

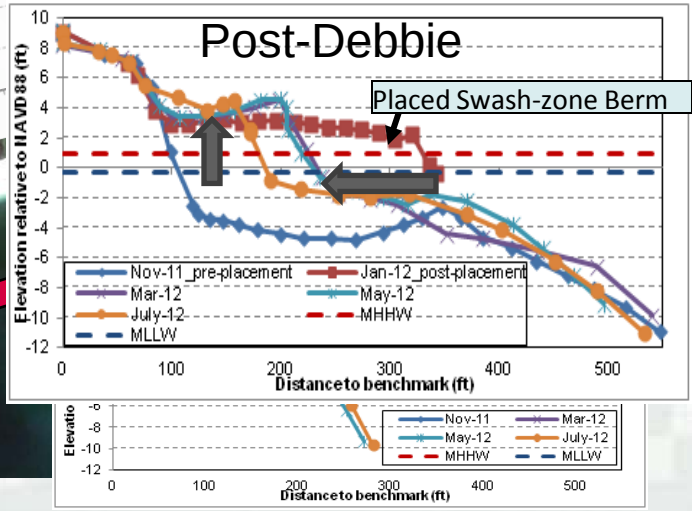

- Sediment grades coarser away from inlet; fill is uniform inlet material
- Following placement, shoreline erodes landward and shoreface accretes
- Rapid migration furthest from the inlet; lowest erosion rates near the ebb shoal
- Alongshore spreading through the nearshore profile
- Inlet shoreline changes not substantial; limited bayside monitoring

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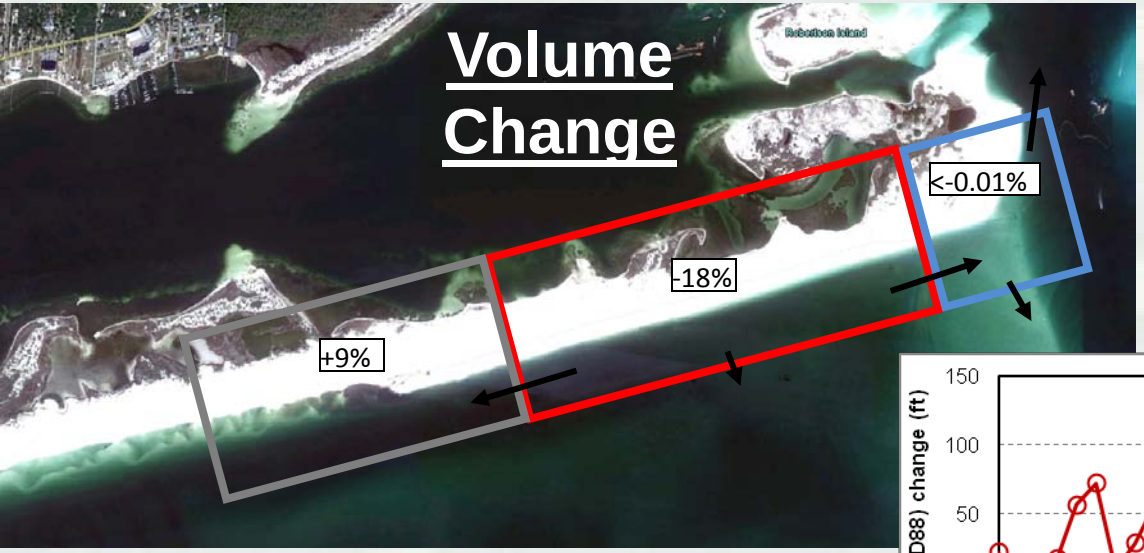
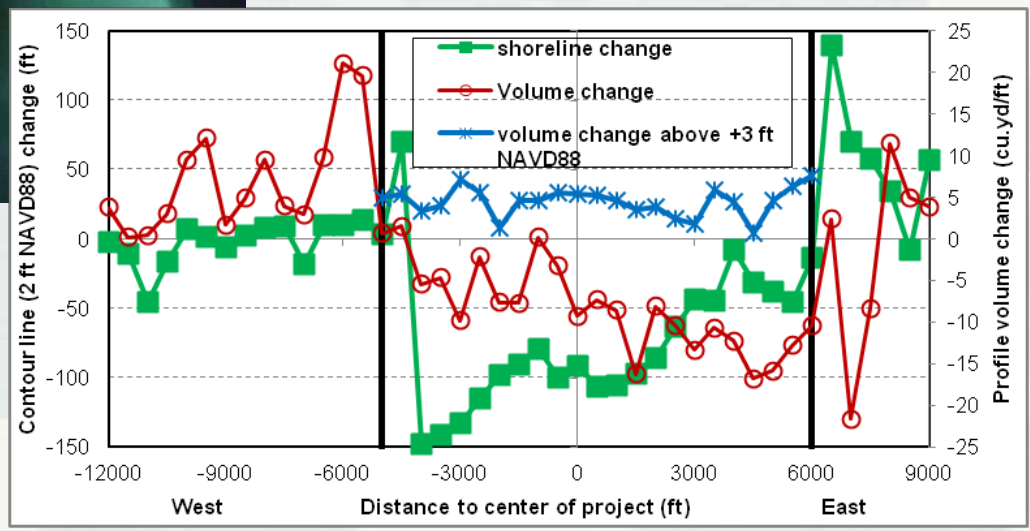
Perdido Key Swash Zone Berm (Jan 2012)



6 Month Volume Calculation



- Accurate means of determining sand volume within and adjacent to the nourished area
- Quantitative method to describe the movement of material

Ft. Myers Nearshore Berm (Jun 2009)

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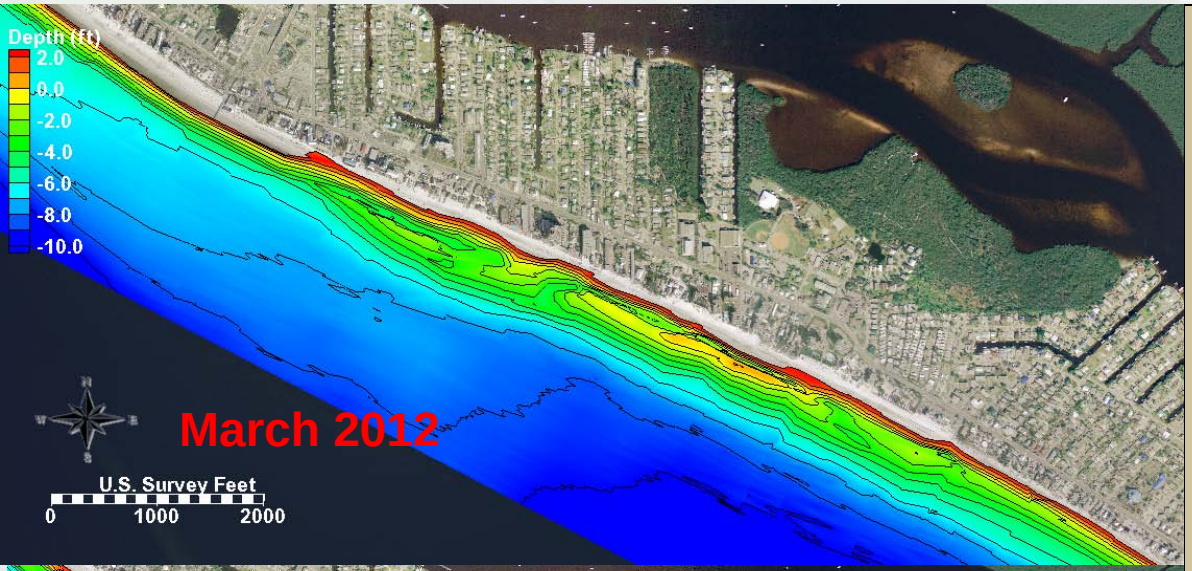

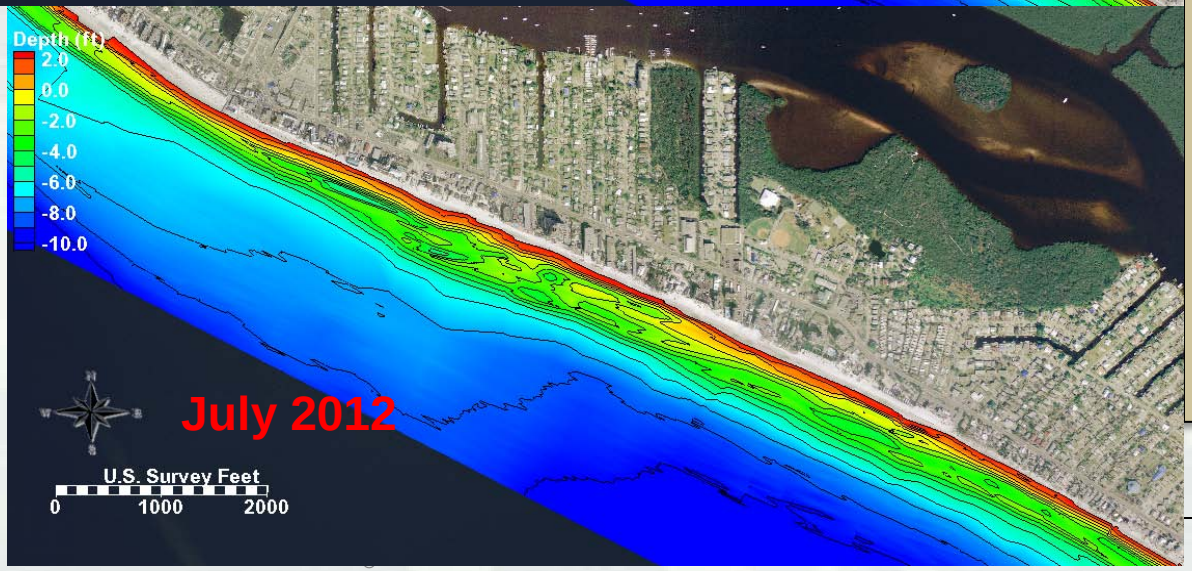

- Fine sediment found in trough and offshore for 1st year; 2nd year none in trough, and coarsening of berm/trough to native grain size as migrating
- Berm migrated 150 ft/yr; characteristic of an asymmetric onshore migrating bar
- Gaps in berm migrated alongshore, but there was little alongshore spreading
- Little effect on shoreline response (low-wave energy)
- Overall, predominantly mobile in the cross-shore, with moderate alongshore spreading

New Smyrna Nearshore Placement (Aug 2012)

www.offshoreswell.com

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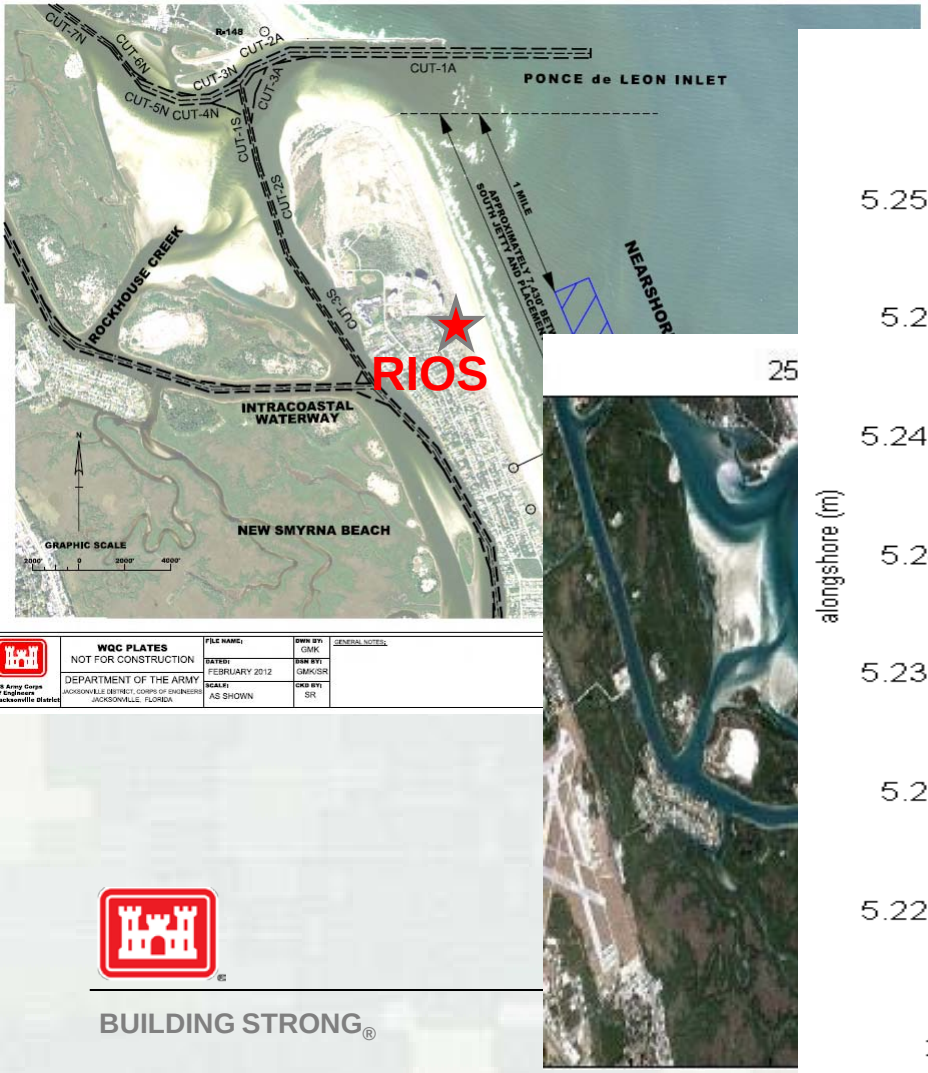
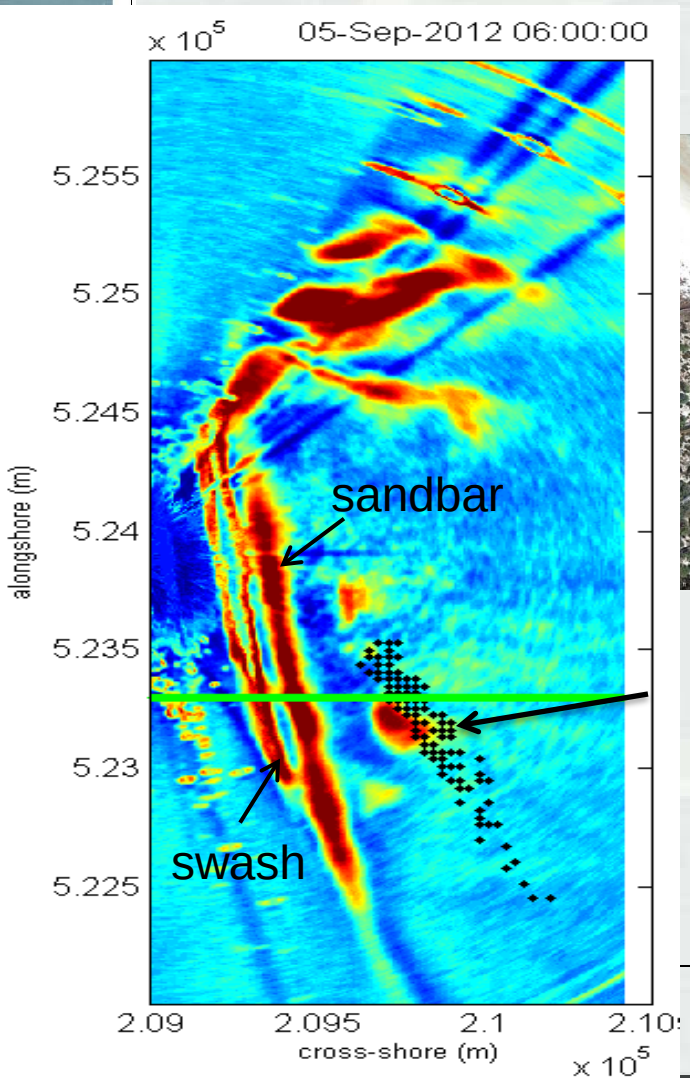
Field Research Facility

RADAR INLET OBSERVING SYSTEM:





Placement locations

BUILDING STRONG®

New Smyrna Nearshore Placement (Aug 2012)

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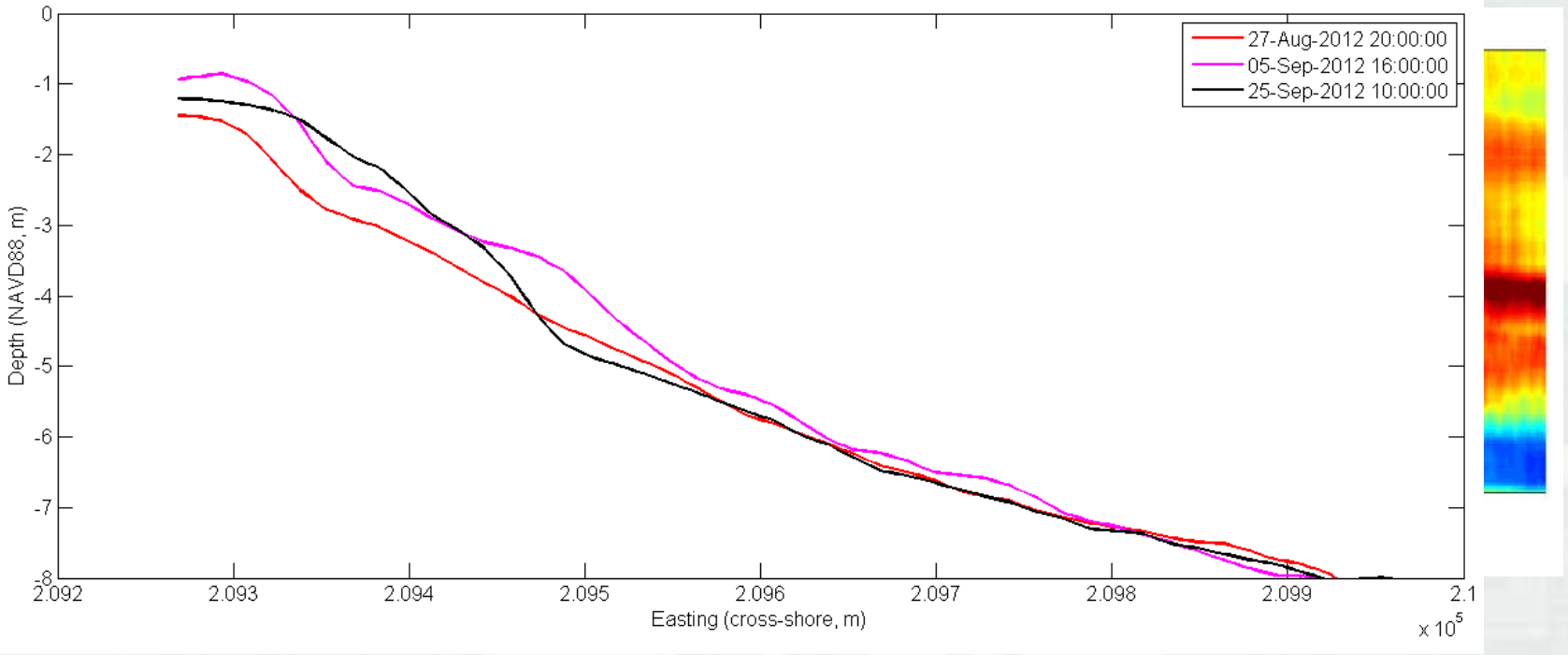
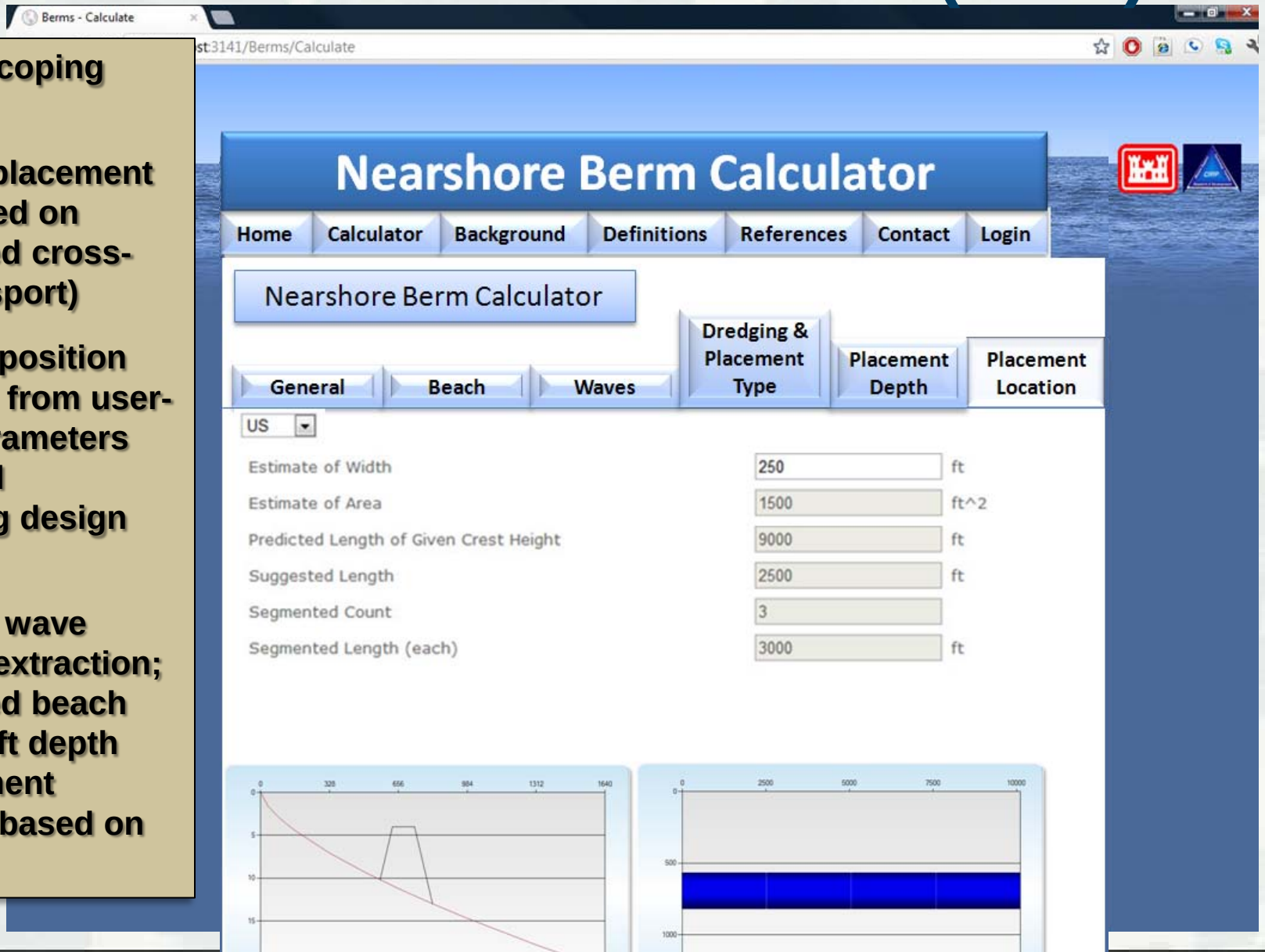


- **Nearshore placement (depth and height above bottom) rarely influences local wave field**
- **Little to no measureable increase in the bed elevation due to placement activities**
- **No measurable indication of shoreline or sandbar response (accretion or erosion) in proximity of placement**

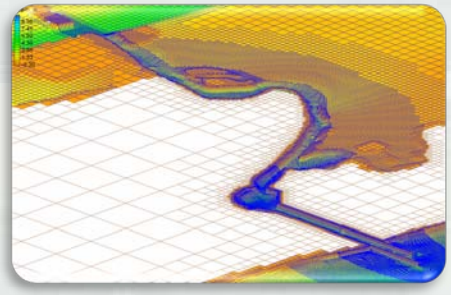
Desktop Planning Tool: Nearshore Berm Calculator (NBC)

- **Planning-Scoping Tool**
- **Estimates placement depth (based on wave-limited cross-shore transport)**
- **Calculates position and design from user-defined parameters and coastal engineering design practices**
- **Automated wave parameter extraction; user-defined beach profile; draft depth and placement limitations based on dredge**



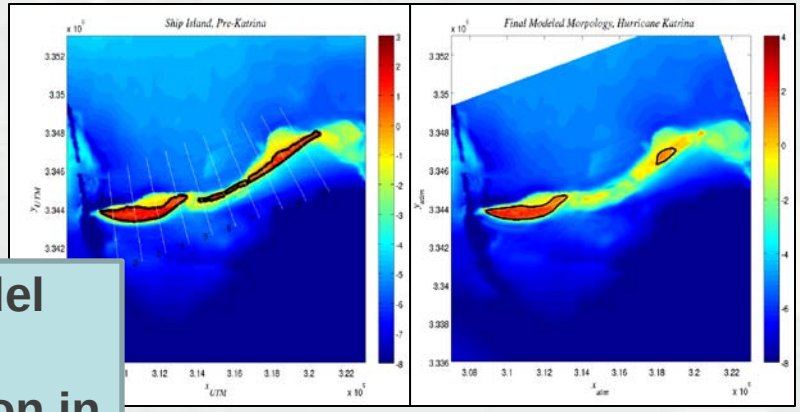
Modeling

CMS

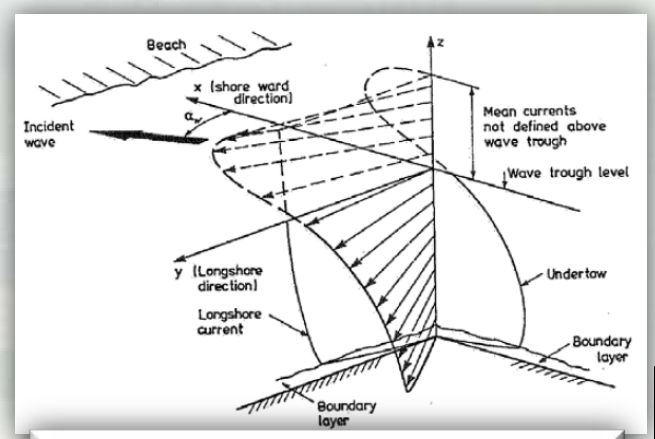


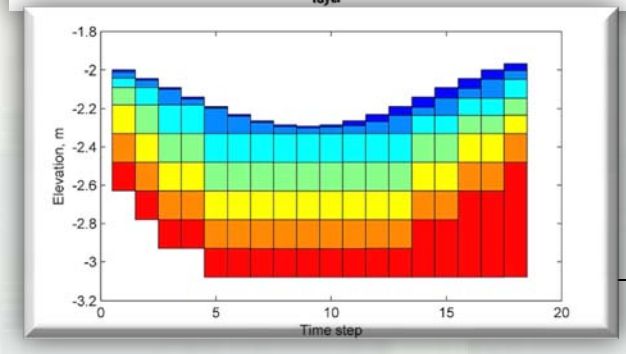
← Validated 2DH Coastal Model that simulates vertical variation of horizontal velocities and includes mixed sands

CShore



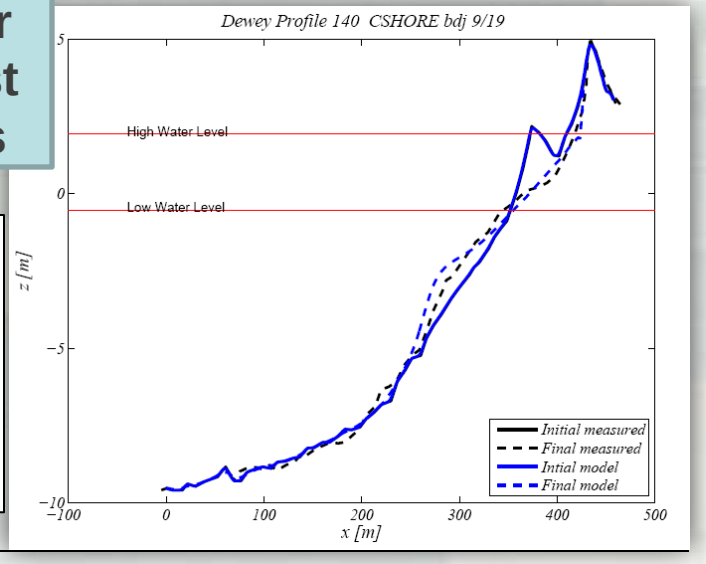
1D Coastal Model → validated for erosion/accretion in the cross-shore for both East and West Coast Applications





Surf Zone Processes:

Undertow
Stokes Drift
Wave Asymmetry
Separated Bed and Suspended Load



Goals for Nearshore Berm R&D

What are we going to get out of our monitoring efforts?

Characterized Environments for Prediction

Input for Empirical Models

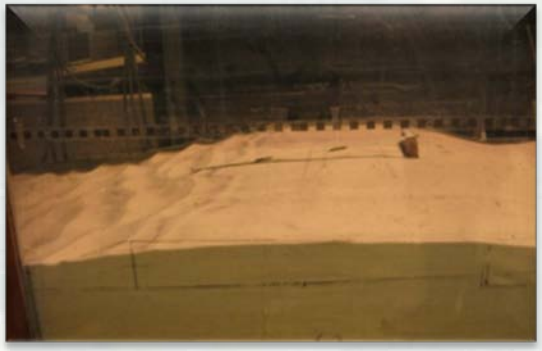
Numerical Modeling Datasets

What do these tools provide ?

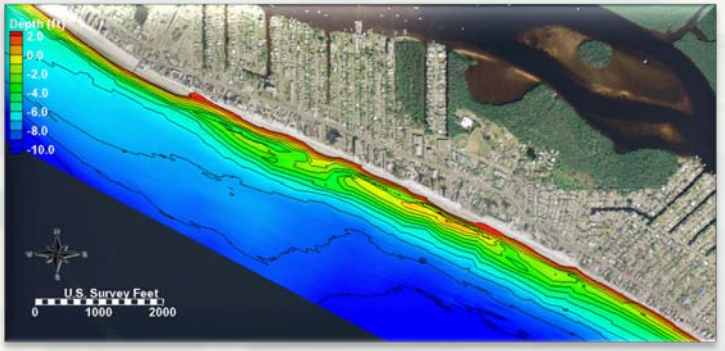
Mobile Tools

Documentation of Results

Numerical Modeling Methodology



Summary



- A need exists for improved prediction of nearshore placement behavior, and a more comprehensive understanding for guidance on placement types and the various environmental factors influencing long-term performance
  - Basic design parameters exist [depth limits, gap spacing, end slopes], but are insufficient in predicting performance
  - Documentation is very limited
- Laboratory experiments isolate various parameters and analyze that part of sediment transport and morphology change
- Various nearshore placement activities have been monitored for necessary documentation, and to better define performance metrics. Key Factors include:
  - Cross-shore transport rates for a given wave climate and ambient sediment transport
  - Alongshore spreading of placement material under various environmental forcings
  - Temporal incorporation into natural coastal morphology (beach profile)
  - Displacement/migration of concentrated fines

Thank You

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Questions to Discuss

- Are there studies with the performance of material with different % fines in similar placement areas and wave climate, to determine what % fines works and what doesn't?

- How do we know what will happen if we place material along a stretch of beach that has not be modeled or analyzed?

- How do we know that what worked in one area (e.g. new Smyrna) will work in another (e.g. Melbourne)? How can we correlate these?

Questions to Discuss

- How many O&M projects in FL actually have viable quantities of exclusively nearshore compatible material per state standards? (ie beach quality, except fines between 10 & 20 %)

- If the majority of material is beach quality, in order to justify nearshore placement using small equipment such as the Currituck, quantify the economic and ecologic benefit of utilizing small scale "strategic" dredging to hit just critical shoals and expanding the interval between large scale dredging events at the project (maybe go from 3 to 5 years between large scale, traditional dredging events with beach placement). How does this correspond to the funding environment the Corps currently faces, especially for shallow draft nav projects.